Model-based design of integrated horticultural systems: contributions using multiobjective optimization methods

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Plan

- Introduction
- The developed model
- The optimization problem
- The proposed approach
- Results
- Conclusion and prospects

Introduction

The Integrated Fruit Production:

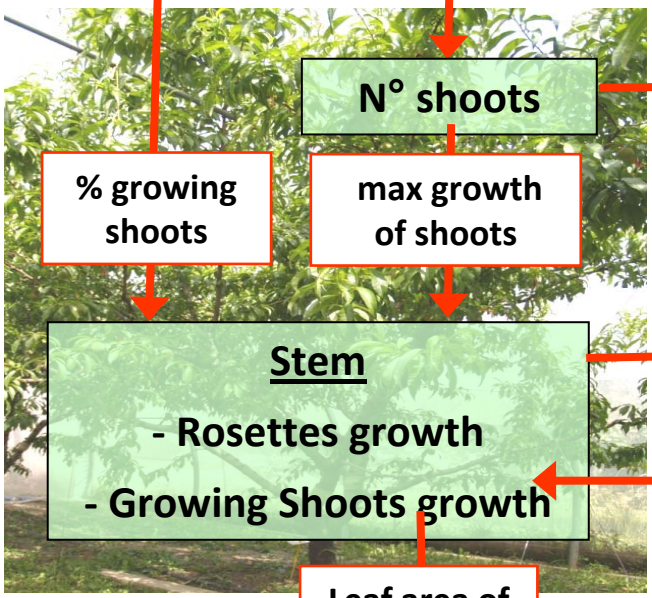
- **economical** requirements
- Organoleptic and health **quality** of fruits
- **environment** preservation**:**

  Reduce the use of **pesticides**

Adaptation of production processes to improve crop quality and environment safety :

- Rational chemical control
- Integration of **alternative methods**

The developed model



Pruning

N Fertilization

insecticides

emigration

N° shoots

% growing shoots

max growth of shoots

Intrinsic rate of pop increase

mortality

Aphids' growth

Stem

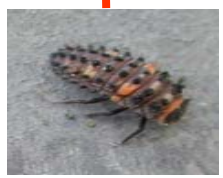
- Rosettes growth
- Growing Shoots growth

Intra-specific competition coef

Fall and damages

Leaf area of the tree

predation



Fruit growth

N° fruits

Thinning

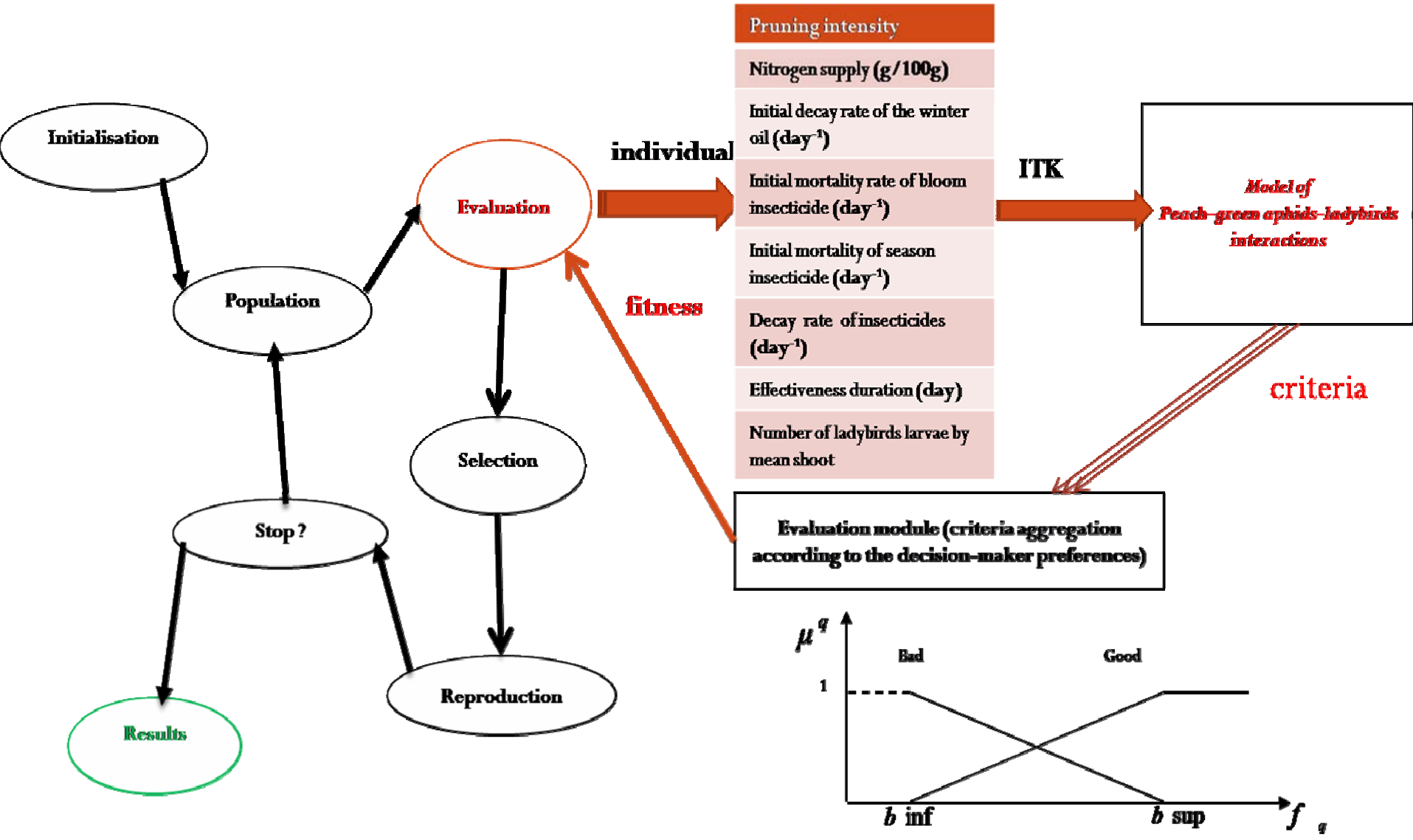
Quality (RI)

Ladybird release

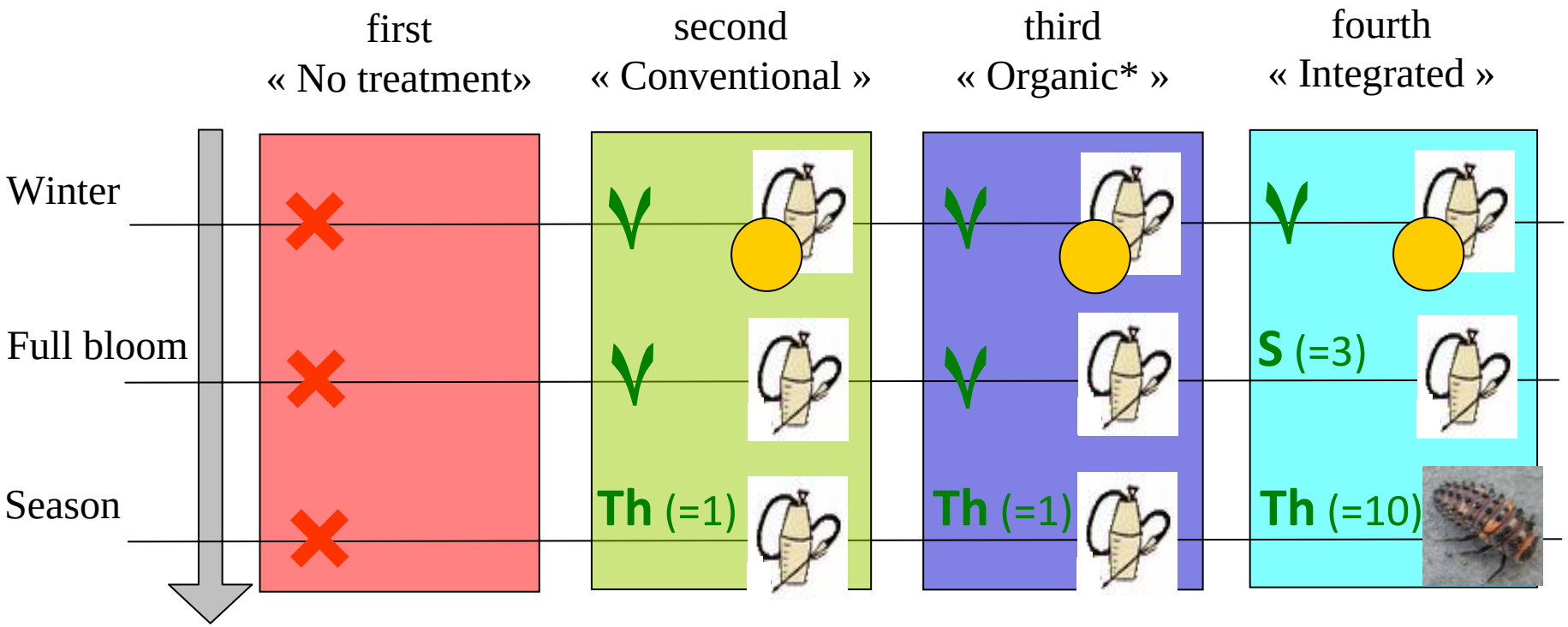
The optimization problem

- Decision variables
  - ✓ Pruning
  - ✓ Nitrogen supply
  - ✓ Pesticides characteristics
  - ✓ Winter oil characteristics
  - ✓ Released ladybirds number
- Criteria
  - ✓ Fresh mass
  - ✓ Yield
  - ✓ Refractometric index
  - ✓ Selling price
  - ✓ Total quantity of ladybird instars released
  - ✓ Number of insecticide applications
  - ✓ Total number of aphids
  - ✓ Number of growing shoots per tree
  - ✓ Proportion of growing shoots > 30cm

The proposed approach

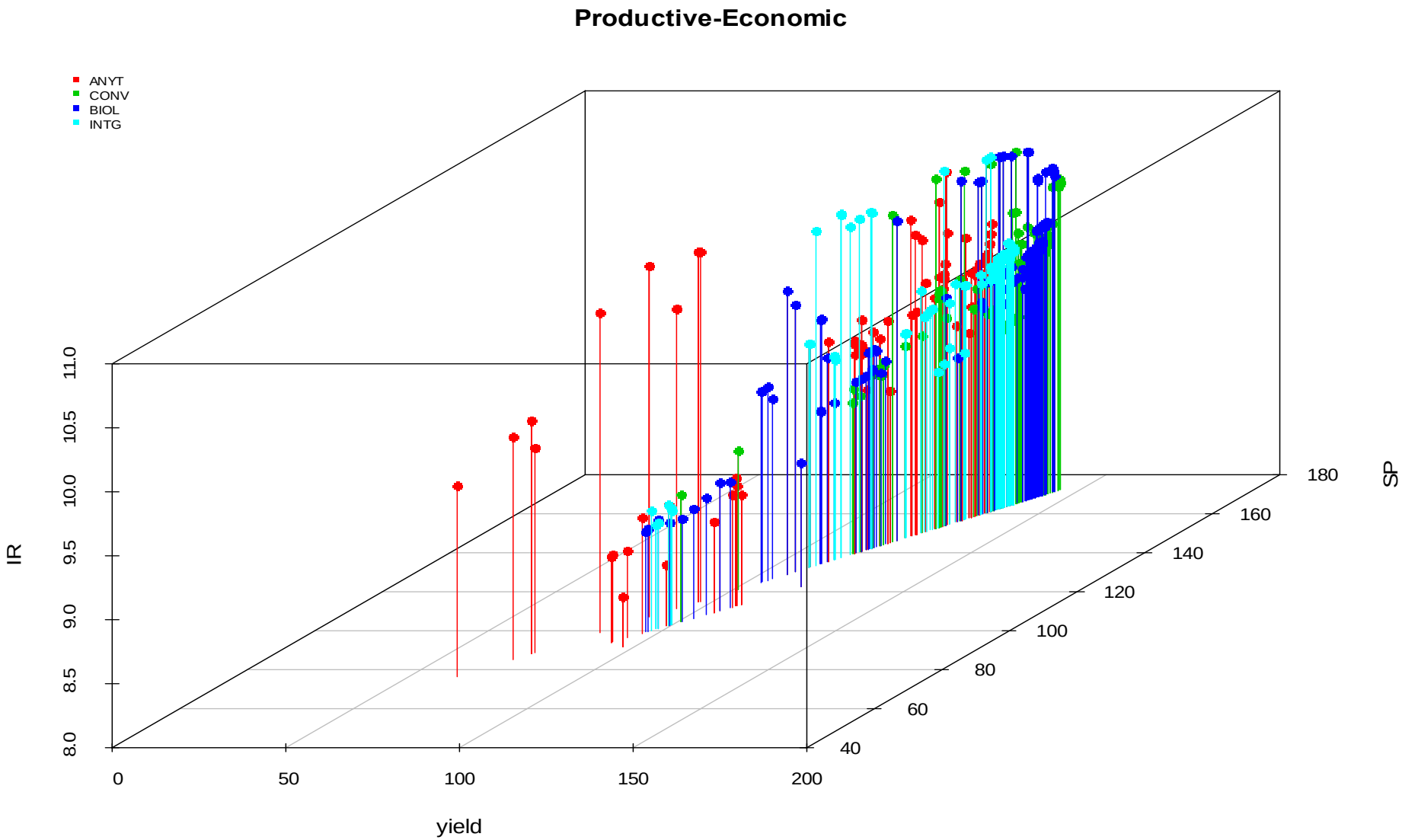


The proposed approach

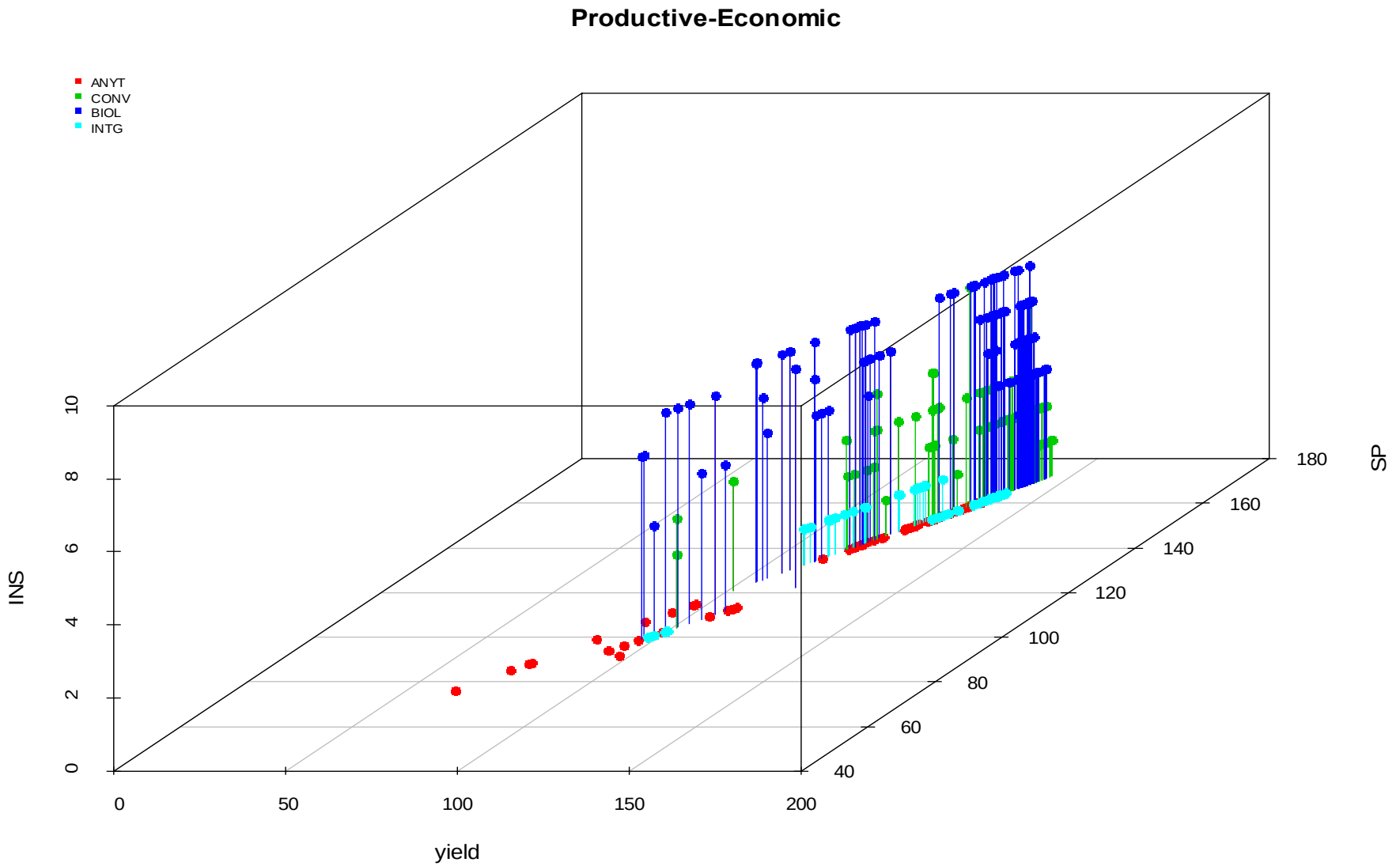


	Mfr	Yield	SP	RI	nGS	pGS30	INS	TotN_LA	TotN_APH
PR_ECO	2	2	3	2	0	0	0	1	0
PR_DR	2	3	1	0	2	2	0	0	0
ENV_ECO	1	1	2	0	1	0	3	1	1

Results


Productive-Economic
ANYT
CONV
BIOL
INTG
IR
8.0
8.5
9.0
9.5
10.0
10.5
11.0
yield
0
50
100
150
200
SP
40
60
80
100
120
140
160
180

Results


Productive-Economic
ANYT
CONV
BIOL
INTG
INS
0
2
4
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8
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0
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200
yield
40
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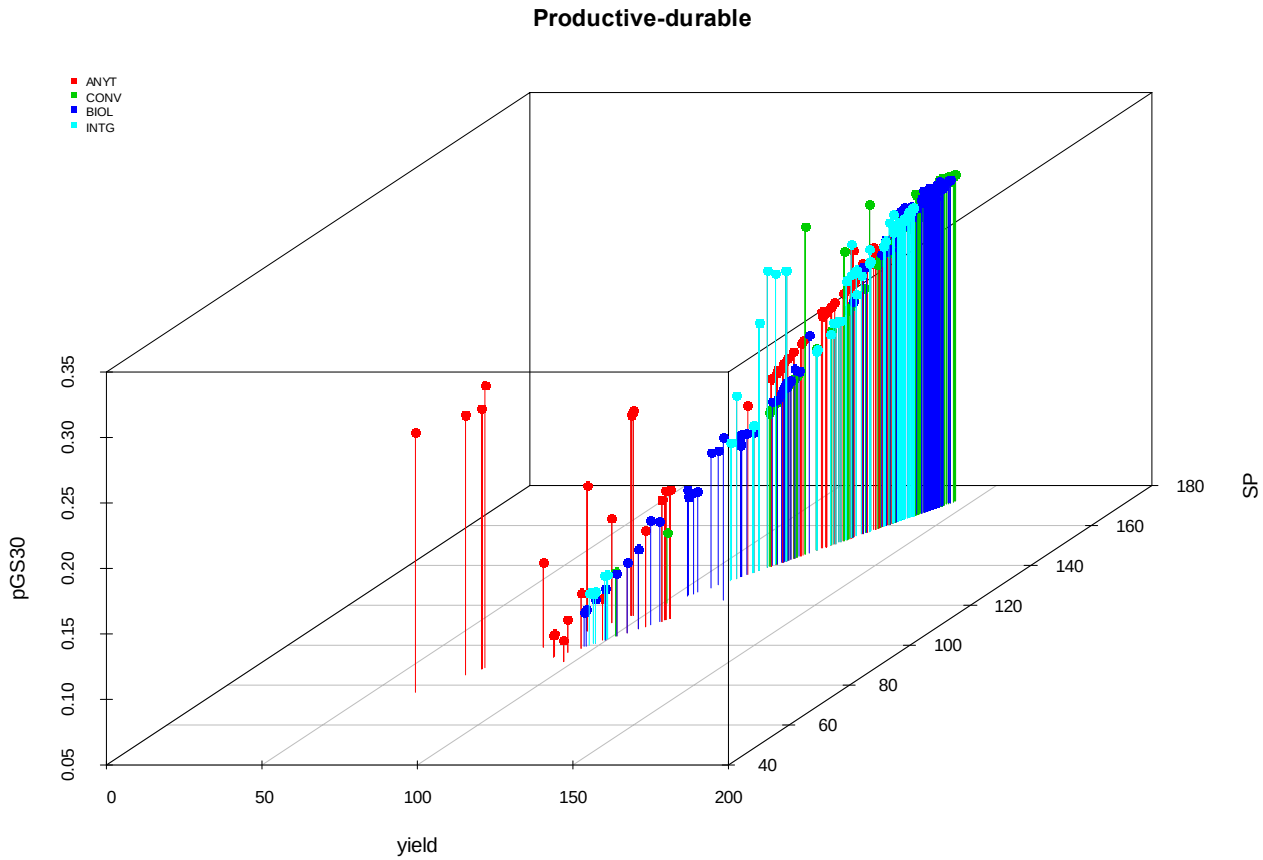
SP

Results


Productive-durable
ANYT
CONV
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INTG
pGS30
0.05
0.10
0.15
0.20
0.25
0.30
0.35
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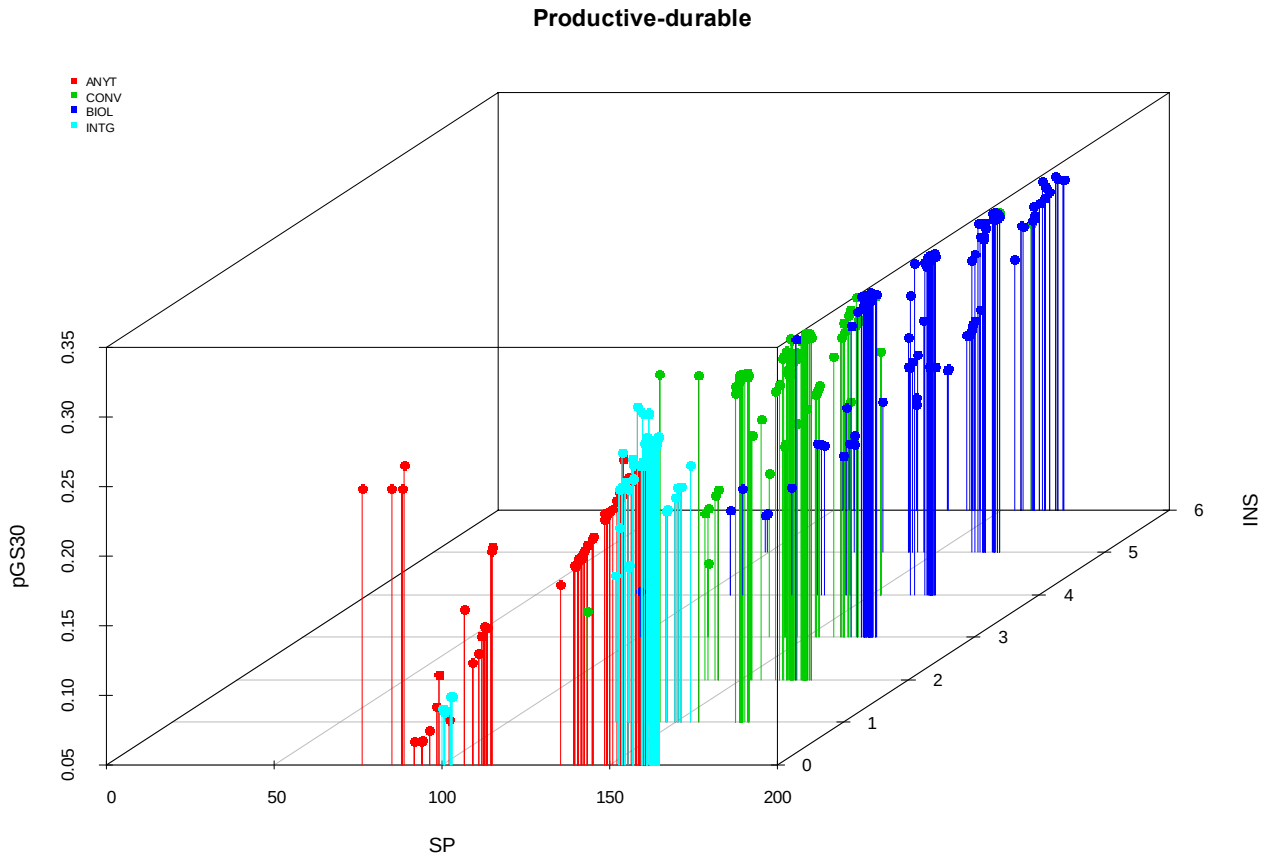
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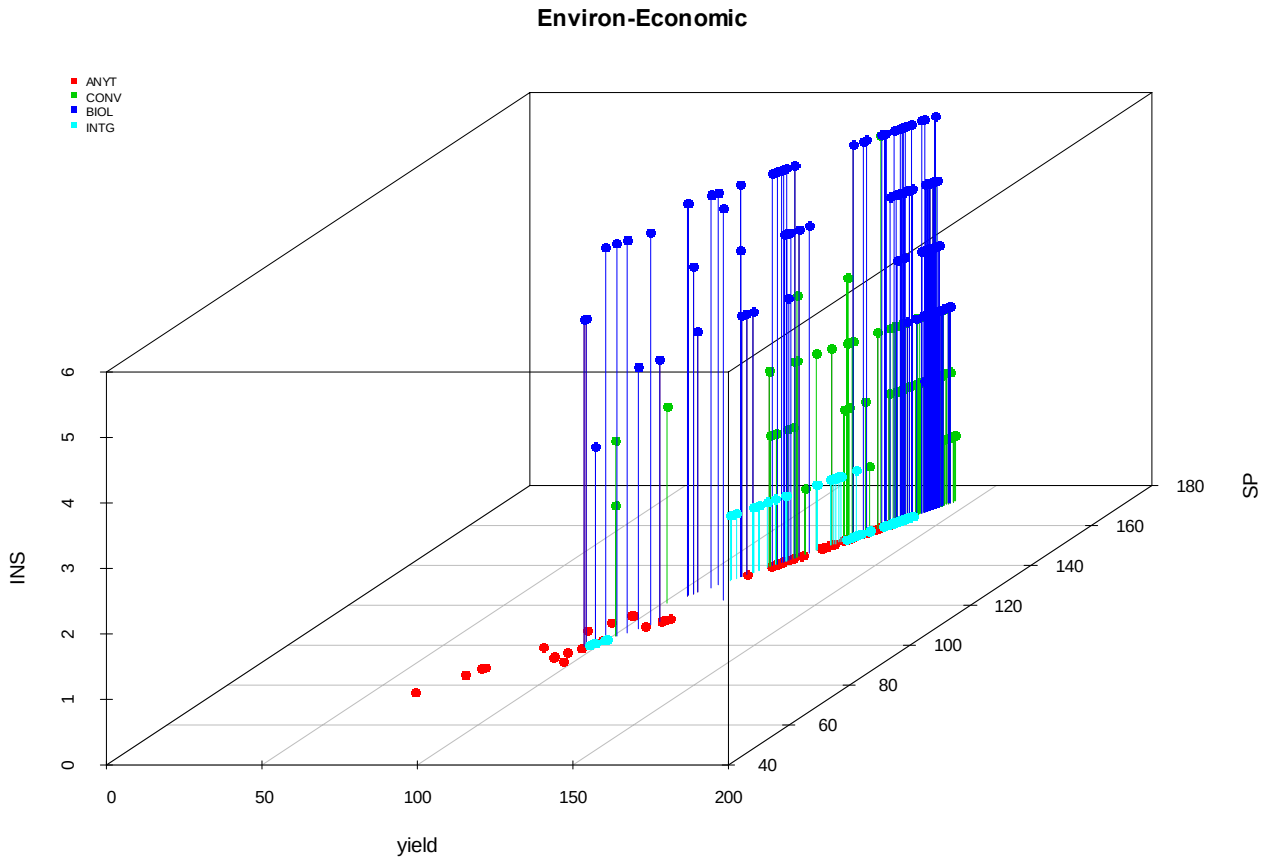
Environ-Economic
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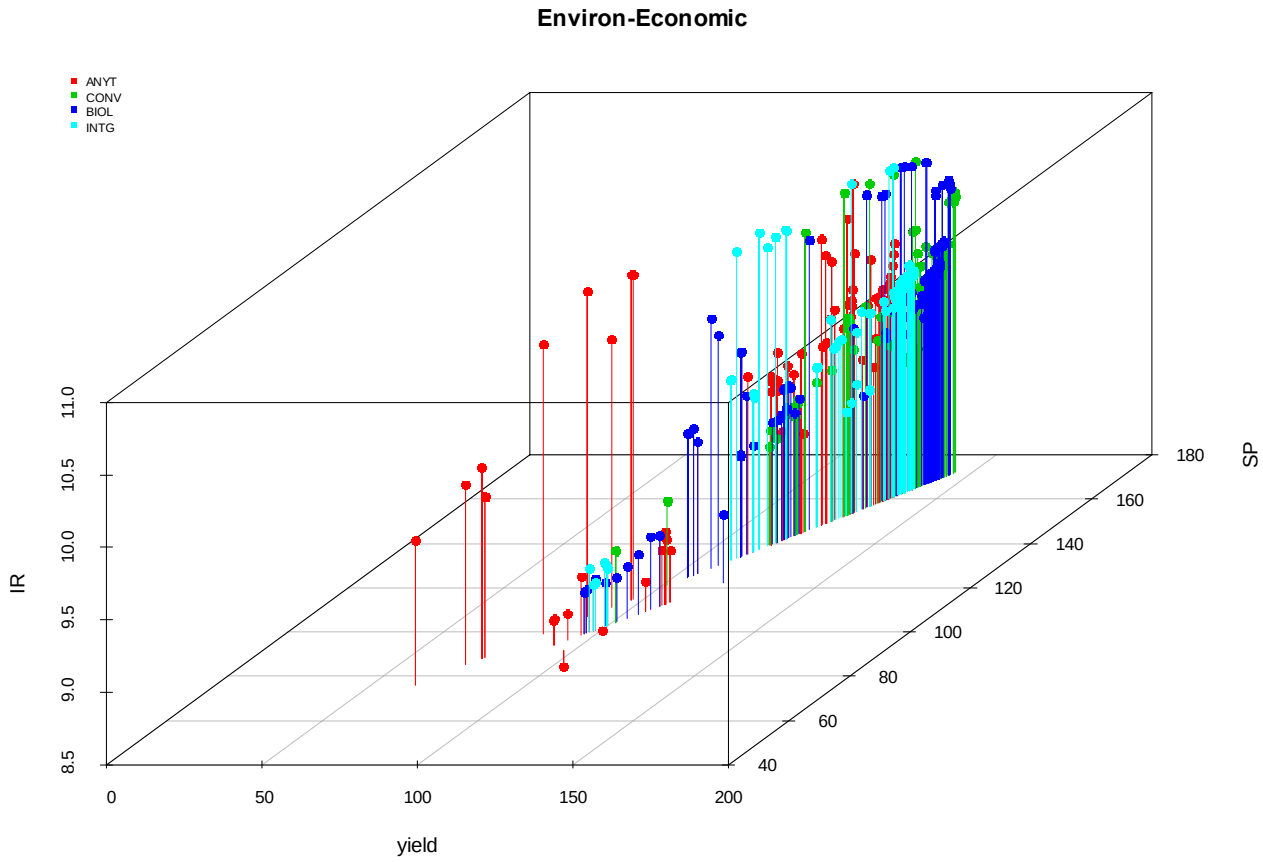
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Conclusion & perspectives

- An evolutionary algorithm to design technical scenarios for integrated fruit production
- Exploring a wide search space and identifying potentially interesting and feasible solutions

- Reformulate the optimization problem
- Design and test new protection strategies
- Develop a non-aggregative approach based on the concept of Pareto dominance.
- Compare theses two approaches

Thank you for your attention!